Go over homework circular motion
Theory for the flying pig lab next class
Banking
go over test

eg. 1. You drive a car at 20.0m/s around a corner radius 40.0 m.

a) what is the acceleration of the car?

$a=v^2/r = (20.0 m/s)^2/40.0 m = 400\ m^2/s^2/40 m$

$a=10.0\ m/s^2$

towards the centre of the circular path.

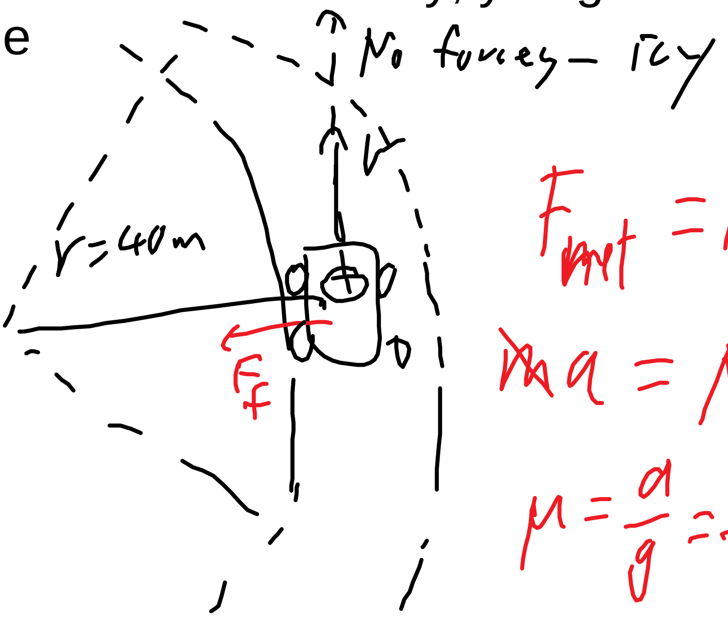
b) what is the net force on the 500.0 kg car?

$F_{net}=ma = 500.0 kg \times 10.0 m/s^2 = 5.00 \times 10^3\ N$

towards the centre of the circular path

c) what is the minimum coefficient of friction to keep the car from skidding?

friction is the only force holding the car in the circular path - if the road is icy, you go in a straight line



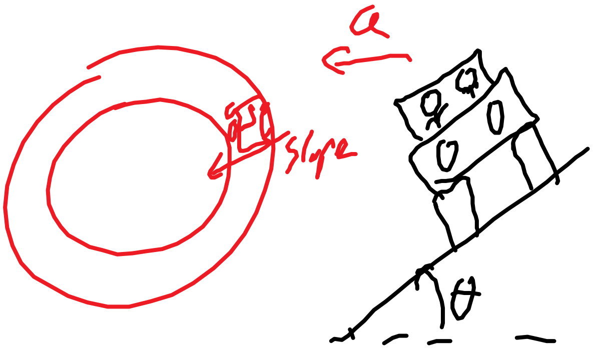
$F_{net} = F_f$

$ma = \mu m g$

$\mu = \frac{a}{g} = \frac{10}{9.8} = 1.02$

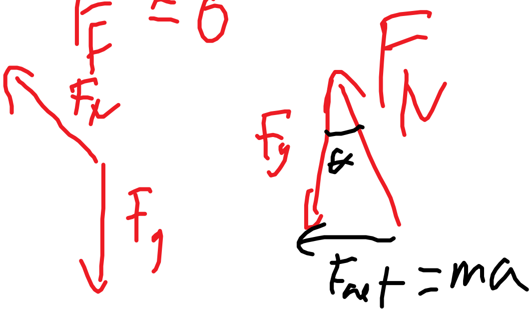
d) you can slope the road to help cars go

around corners. What angle of slope would best work for the above scenario?



if θ is perfect for v and r

$F_F = 0$



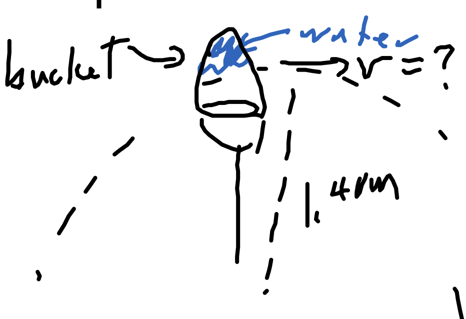
$$\tan\theta = \frac{ma}{mg}$$

$$\tan\theta = \frac{a}{g} = \boxed{\frac{v^2}{rg} = \tan\theta}$$

$$\theta = \tan^{-1}\left(\frac{(20\,m/s)^2}{40m(9.81\,m/s^2)}\right) = \boxed{45.6°}$$

1. You swing a bucket of water in a vertical plane.

a) what is the minimum speed of the bucket to keep the water from spilling out? r=1.40m

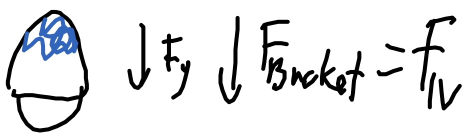


a = g at minimum speed

$$a = g = \frac{v^2}{r} \qquad v = \sqrt{gr}$$

$$v = \sqrt{9.81\,m/s^2 \cdot 1.4m} = \boxed{3.7\,m/s}$$

b) What is the force on 2.0 kg of water from the bucket i) at the top?



$$a = \frac{v^2}{r}$$

$$a = \frac{(2\pi r f)^2}{r} = 4\pi^2 r f^2$$

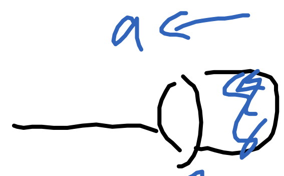
 $\downarrow F_g$ $\downarrow F_{Bucket} = F_N$ $a = \frac{(2\pi r f)^2}{r} = 4\pi^2 r f^2$

$F_g + F_N = F_{net} = ma$ $a = 4\pi^2(1.4m)(2\,cy/s)^2$

$a = 221\,m/s^2$

c) $F_N = F_{net} - mg = 2kg(221\,m/s^2 - 9.8) = \boxed{423N}$

d) ii) at the side iii) at the bottom if you are
swinging the bucket with a radius of 1.40 m
2 revolutions per second. ← $f = \frac{cycle}{s}$ $v = \frac{d}{t} = \frac{2\pi r}{T} = 2\pi r f$

ii) 

$F = 2kg(221\,m/s^2) = 442N$

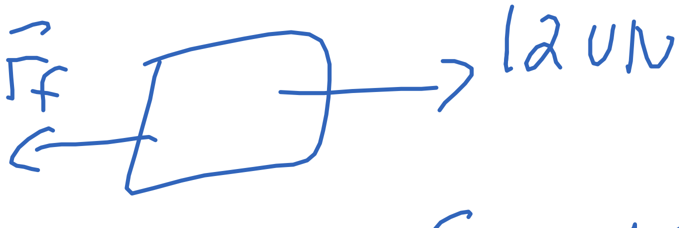
iii) 

$F_N - F_g = ma$

$F_N = ma + mg = 2kg(221\,m/s^2 + 9.8)$

$\boxed{F_N = 462N}$ at bottom

p119 questions 1-5, p120 problems 1-15 odds
note q15 is really hard, have fun.
p123 General Problems 52, 57
Lab next class - not in labbook



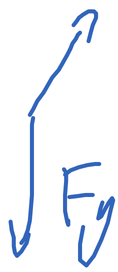
$F_f = \mu F_N = \mu mg$

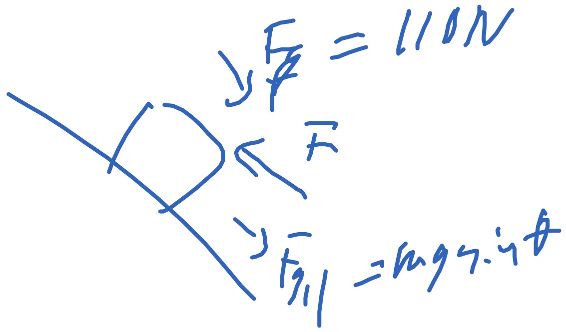
$$\overset{\quad}{120N - \mu(35)(9.8)} = \overset{m}{35}\,\overset{a}{(1.8)}$$

$$\mu = 0.17$$

13 $F = ma = (4.0kg)(2\,m/s^2)$

$= 8N$





$F = 110N + 15(9.8)\sin 35$

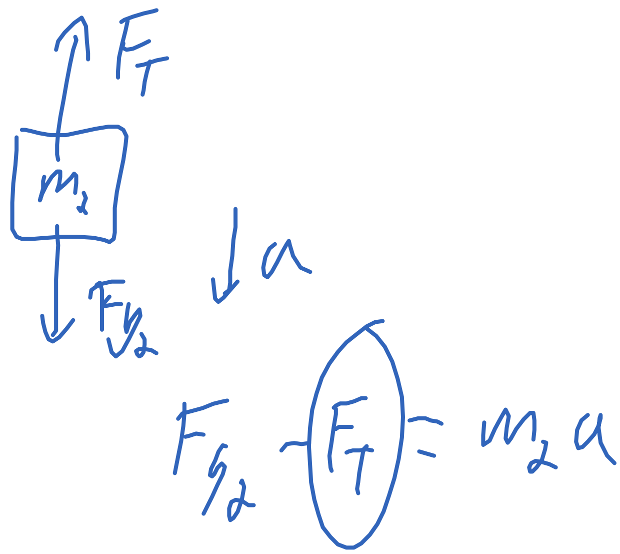
$= 190N$

16 $F_{net} = (m)a$

$7 + 1 + 5\,kg$

$5kg(9.8) - 1kg(9.8) = 13a$

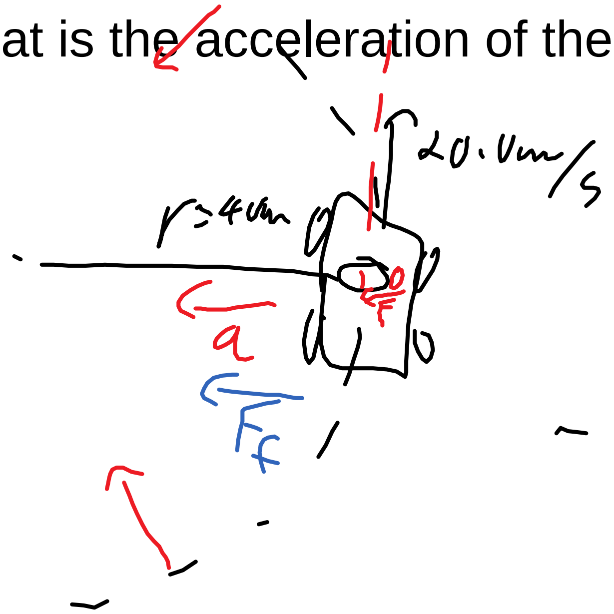
$\boxed{a = 3.0\,m/s^2}$



Block 2-3

eg. 1. You drive a car at 20.0m/s around a corner radius 40.0 m.

a) what is the acceleration of the car?



$a = \frac{v^2}{r} = \frac{20^2}{40}$

10.0

$a = 10\,m/s^2$

– towards the centre of the path

b) what is the net force on the 500.0 kg car?

$F_{net} = ma = 500 \times 10 = 5{,}000 = 5.00 \times 10^3$ N

towards the centre of the circular path

b) what is the minimum coefficient of friction to

keep the car from skidding?

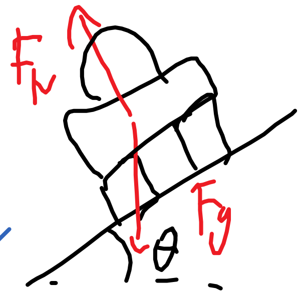
$$\mu = \frac{F_f}{F_N} = \frac{F_{net}}{F_g = mg} = \frac{5000\,N}{500\,kg \times 9.8\,N/kg} = \boxed{1.02}$$

big

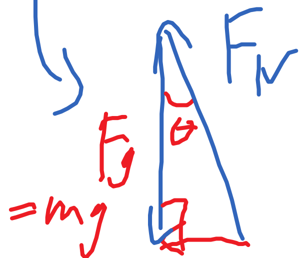
No units

tires are about 0.7

d) you can slope the road to help cars go around corners. What angle of slope would best work for the above scenario?



if θ is just right for v and r $F_f = 0$ required



$$F_{net} = ma = \frac{mv^2}{r}$$

$$\tan\theta = \frac{ma}{mg}$$

$$\boxed{\tan\theta = \frac{v^2}{rg}} = \frac{20^2}{40(9.8)}$$

$$\theta = \tan^{-1}\frac{10\,m/s^2}{9.8\,m/s^2} = \boxed{45.6^\circ}$$

2. You swing a bucket of water in a vertical plane.

a) what is the minimum speed of the bucket to keep the water from spilling out? r=1.40m

a=g at minimum speed

a=g at minimum speed

$a = \frac{v^2}{r}$

$v = \sqrt{gr} = \sqrt{9.8\,m/s^2 \; 1.4\,m} = \boxed{3.7\,m/s^2}$

a) What is the force on 2.0 kg of water from the bucket i) at the top? ii) at the side iii) at the bottom if you are swinging the bucket with a radius of 1.40 m 2 revolutions per second.

f=2 rev/s $a= v^2/r$ $v=d/t = 2\pi rf = 2\pi r/T$ where T is the period of revolution = 1/f

$a= (2\pi r/T)^2/r = 4\pi^2 r/T^2 = 4\pi^2 rf^2$

on sheet

$a= 4\pi^2(1.40m)(2\,rev/s)^2 = 221\,m/s^2$

4x3.14x3.14x1.4x4=220.855

v= 2x3.14x1.4x2=17.584

$F_{net} = \Sigma F =$

top $F_N + F_g = ma$

$F_N = ma - mg = 2.0\,kg\,(221m/s^2 - 9.8m/s^2)$

F_N = 423N at the top

middle - Fg is perpendicular, so we ignore it

$F_N = F_{net} = 2.0\,kg \times 221\,m/s^2 = 442\,N$

bottom F_N is up while F_g is down so

$F_N - F_g = ma$

$F_N = ma + mg = 2.0\,kg\,(221m/s^2 + 9.8m/s^2)$

F_N = 461 N - largest at the bottom

p119 questions 1-5, p120 problems 1-15 odds
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Block 2-4

eg. 1. You drive a car at 20.0m/s around a corner radius 40.0 m.

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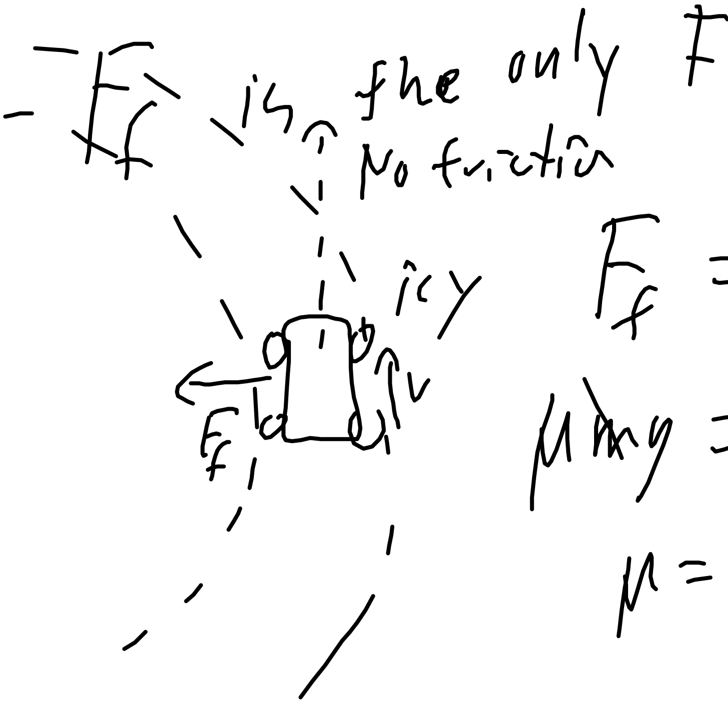
$=10.0\ m/s^2$
towards the centre of the circular path

b) what is the net force on the 500.0 kg car?
$F_{net}=ma = 500kg \times 10\ m/s^2 = 5.00\times10^3$ N
towards the centre of the circular path

c) what is the minimum coefficient of friction to keep the car from skidding?



$F_f = F_{net}$

$\mu mg = ma$

$\mu = \frac{a}{g} = \frac{v^2/r}{g}$

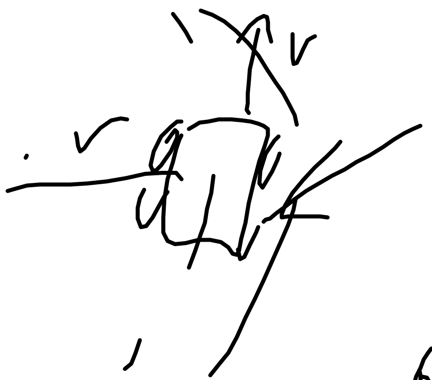
$\mu = \frac{10 m/s^2}{[illegible]} = 1.02$

$$\mu = \frac{10\ m/s^2}{9.8} = \boxed{1.02}$$

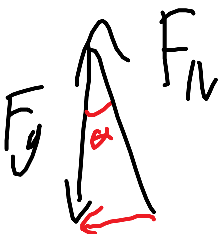
No units

tires & pavement $\mu \sim 0.7$

d) you can slope the road to help cars go around corners. What angle of slope would best work for the above scenario?



at perfect θ, No friction is required



$F_{net} = ma$

$$\tan\theta = \frac{ma}{mg}$$

$$\boxed{\tan\theta = \frac{a}{g} = \frac{v^2}{rg}}$$

$$\frac{20^2}{40(9.8)}$$

$$\theta = \tan^{-1} \frac{10\ m/s^2}{9.8\ m/s^2} = \boxed{45.6^\circ}$$

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